

EFFECTS OF CAPTURE AND CAGING ON THYROID ACTIVITY OF HOUSE SPARROWS¹ (*PASSER DOMESTICUS*)

BARBARA F. BROCKWAY²

Department of Zoology and Entomology, The Ohio State University, Columbus, Ohio 43210

ABSTRACT

The effects of length of caging and reserpine administration on the *in vivo* recording of uptake and retention of iodine-131 by the thyroid glands of House Sparrows (*Passer domesticus*) were investigated.

The uptake of iodine-131 was lower in birds caged for shorter periods (2 and 10 days) as compared to those caged for longer periods (90 and 100 days) prior to testing. The release of radioiodine from the thyroid area as measured by logarithmically plotted "release slopes" seems depressed in birds held only 2 days prior to testing. Release in birds held for 10 days did not differ appreciably from that in birds held 90 days prior to testing.

Uptake and retention of iodine-131 did not differ significantly between birds given reserpine and those given a placebo, either in a group of birds tested 2 days or one tested 90 days after capture.

The advantages of *in vivo* recording of uptake and retention of iodine-131 by the thyroid glands can be seriously overshadowed, in cases of wild-living animals, if the effects of capture and length of confinement prior to testing are not considered. The present study was undertaken to determine if capture and caging might affect such measurements in House (English) Sparrows. The effects of a tranquilizer (reserpine) on the uptake and retention of iodine-131 were also tested.

MATERIALS AND METHODS

Birds

House Sparrows are easily obtained throughout the year, but do not readily habituate to captivity. Approaching a cage of newly captive birds typically results in their violently flying about the cage and colliding with cage sides and others. Several days after capture such pandemonium upon approach ceases after several minutes and birds perch in a sleeked, erect, alert posture oriented to the observer. After many weeks of captivity they are still easily disturbed, but more rapidly resume other activities, such as preening or eating. Adults of both sexes were trapped as needed in the Ithaca area. They were routinely kept in 2×2×3 ft cages, but approximately 24 hr before testing were transferred to smaller 12-inch square cages to facilitate handling. All birds were kept indoors at a room temperature of approximately 70 F from time of capture throughout testing. Cages were near windows and the resulting natural photoperiods were supplemented by electric lighting only between 9 AM and 4 PM. Thus, those individuals captured earlier received in captivity a daily photoperiod similar to their still wild-living counterparts captured later. Food, a mixture of canary, red millet, white millet, and niger seed, and artesian well water were provided *ad libitum*. Birds weighed approximately 23 g and no significant weight changes were found between experimental groups.

Equipment

A scintillation detector (see fig. 1), consisting of a thallium-activated sodium iodide crystal (National Radiac Inc.) $\frac{1}{2}$ inch in diameter by 1 inch in length mounted on a flat end photomultiplier tube, was attached to a 64-count integral

¹Manuscript received May 23, 1964.

²Studies conducted at Laboratory of Ornithology, Cornell University, Ithaca, N. Y.

scaler. Lead bricks, $3 \times 2 \times 6$ inches, shielded the detector and formed three sides of a rectangular chamber into which a special bird-holding box could be placed. A 1-inch thick lead plate roofed this chamber. The face of the detector's sodium iodide crystal rested on an 8 mm hole in the chamber roof.

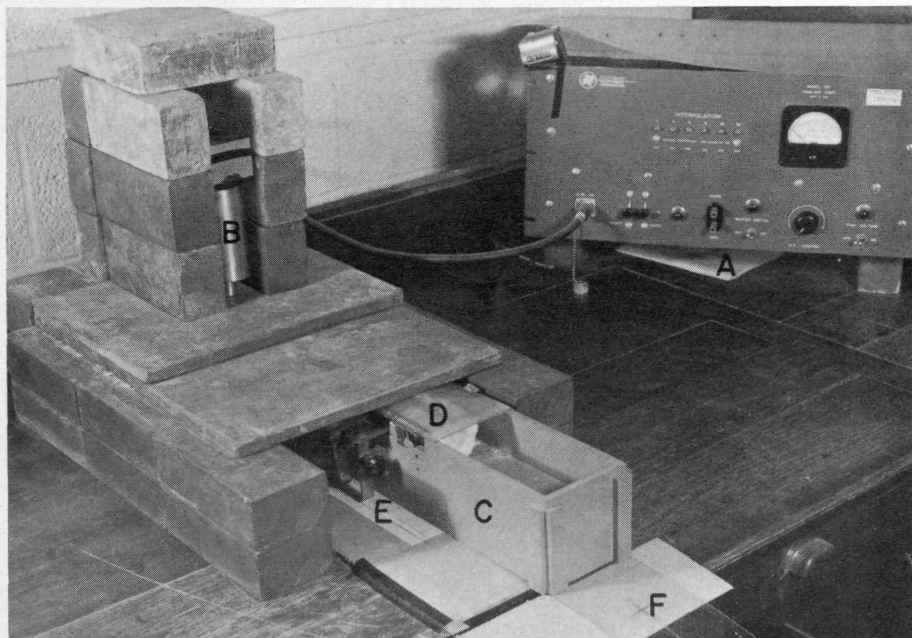


FIGURE 1. Equipment, labeled as follows: (A) integral counterscaler; (B) scintillation detector (the lead bricks in front of this have been removed); (C) bird holding box; (D) graph on plastic lid of box; (E) graph on chamber floor; (F) plastic extension of box. Photo by David G. Allen.

Solutions

A radioactive isotope of iodine (iodine-131), in basic sodium sulfite solution, obtained from the Oak Ridge Laboratories, was diluted in an 0.8 per cent saline solution to a concentration of 5 microcuries per 0.25 cc and this amount injected into the posterior margin of the right pectoralis muscle. Approximately 24 hr before this, 0.12 cc of a 250 mg per cent reserpine solution (Serpasil-Ciba Pharmaceutical Co.) was injected intraperitoneally into certain individuals. This was found to be a critical dosage both for producing tranquility and survival. Control birds received a placebo of 0.8 per cent saline, injected intraperitoneally 2 hr prior to iodine administration.

Procedure and Measurements

Thyroid area radioactivity was measured at intervals beginning 1 hr after injection of the iodine solution and ending 99 hr later. The following procedure was used. A bird was placed in the foam rubber holder of the bird box and the thyroid area beneath the apex of the furculum was located on the transparent plastic graph of the bird box lid. The holder was then adjusted so that this area was held tightly against the closed lid and the bird immobilized. The thyroid area was then located under the sodium iodide crystal by lining a cross on the plastic extension of the box with a correlated graph on the chamber floor. This system, checked and used in a previous study (Fink, 1957), has a placement accuracy of better than 0.2 cm^2 .

Thyroid area radioactivity was counted for 3 min and averaged per bird as counts per minute (CPM). All readings were corrected with respect to background radioactivity and physical decay of the isotope. Data were statistically compared by Fisher's t-test and a probability level of less than 5 per cent was regarded as significant.

Experimental Groups

The following groups were studied: (I), 8 males and 8 females tested 90 days after capture; (II), 10 males and 6 females tested 2 days after capture; (III), 4 males and 4 females tested 100 days after capture; (IV), 5 males and 4 females tested 25 days after capture; and (V), 4 males and 5 females tested 10 days after capture. Fifty per cent of each sex of groups (I) and (II) were given reserpine. All groups were tested between March 23 and April 13 to minimize seasonal variations of gonadal and thyroidal activity.

RESULTS

Effects of Caging Interval

The values for uptake and release of iodine-131 are significantly lower in birds tested 2 days after capture as compared to those tested 10, 25, 90 and 100 days after capture (fig. 2 and 3, table 1). The values for birds caged 10 days prior to

TABLE 1
Significance of points on curves of birds held 90 days vs. 100 days prior to testing

Hours after injection	Means (cpm) of 8 birds held 90 days	S.E.	Means (cpm) of 8 birds held 100 days	S.E.	Difference between the means	S.E. of the difference	"t"	"p"
1.0	2282	± 69	2059	± 167	223	± 181	1.23	>0.05
10.0	5667	± 243	5555	± 118	112	± 270	0.414	>0.05
15.0	4958	± 411	5022	± 66	64	± 416	0.153	>0.05
20.0	5348	± 575	5010	± 378	383	± 688	0.556	>0.05
25.0	5129	± 687	5004	± 612	125	± 920	0.136	>0.05
35.0	4341	± 488	4166	± 566	175	± 747	0.234	>0.05
46.0	3581	± 362	3976	± 760	393	± 842	0.469	>0.05
70.0	3081	± 308	2767	± 515	314	± 600	0.523	>0.05
80.0	3047	± 376	2947	± 617	100	± 723	0.138	>0.05
105.0	2801	± 383	2350	± 300	451	± 486	0.927	>0.05

testing are not significantly different from those caged for 25 days except for slightly higher readings in the latter at 10, 20, and 25 hr after injection. Ten-day figures are significantly lower than 90-day ones only up to 40 hr after injection. No significant differences were found between figures for birds held 90 and 100 days.

Rate of iodine release from the thyroid, as seen by the slope of a line drawn through logarithms of CPM values plotted from 35 to 70 hr after injection, were substantially depressed in birds held only 2 days before testing. By 10 days of caging, iodine release did not significantly differ from that of birds held 90 days before testing (fig. 4).

Effects of Reserpine

Generally, no significant differences were found in uptake and retention of iodine-131 between birds given reserpine prior to testing and those given the placebo (tables 2 and 3). There were, however, two exceptions; one, 15 hr after injection in group (I) and another, 1 hr after injection in group (II).

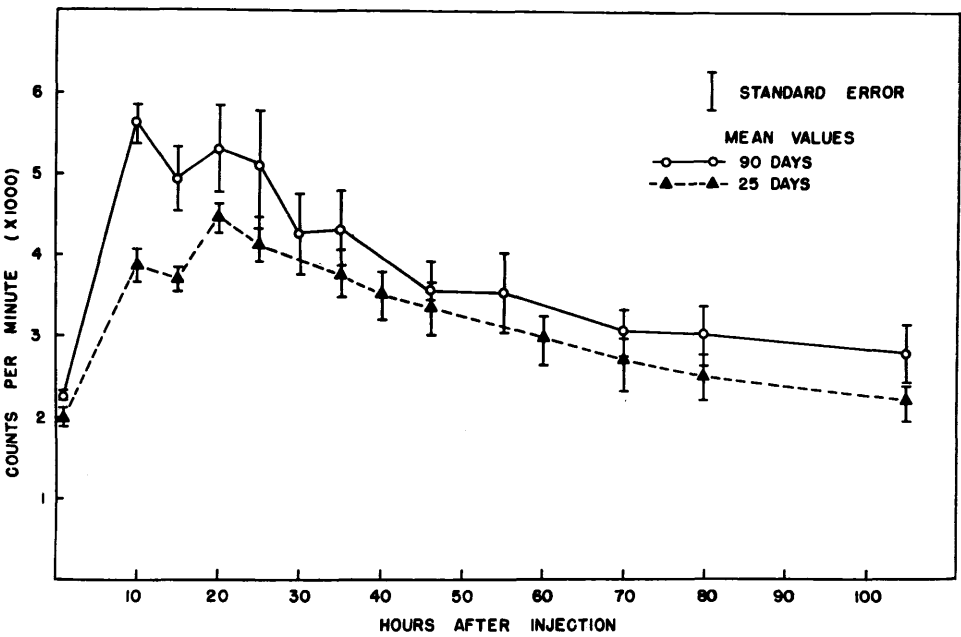


FIGURE 2. Radioactivity of thyroid areas of birds tested 25 and 90 days after capture.

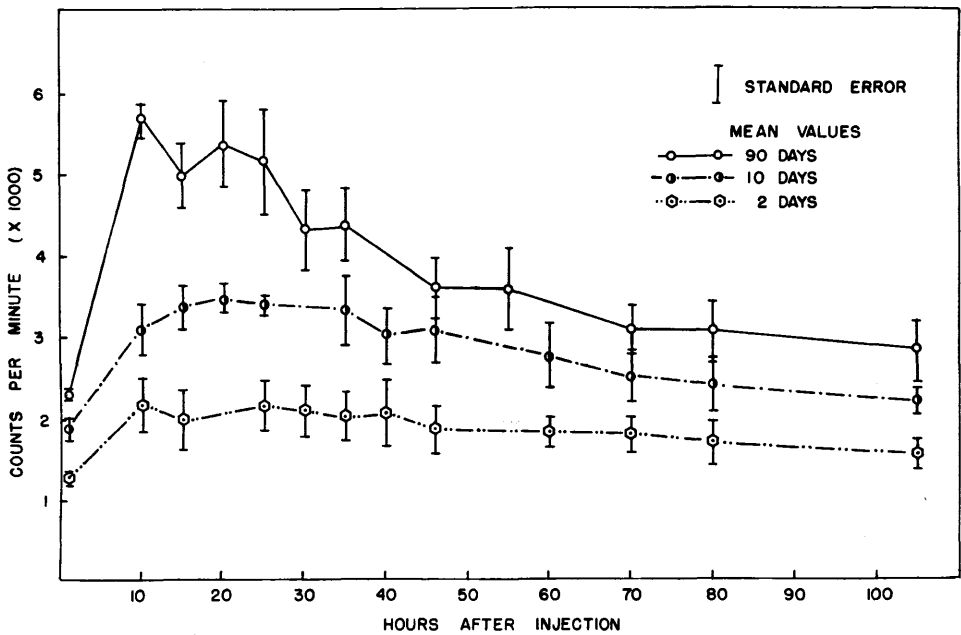


FIGURE 3. Radioactivity of thyroid areas of birds tested 2, 10, and 90 days after capture.

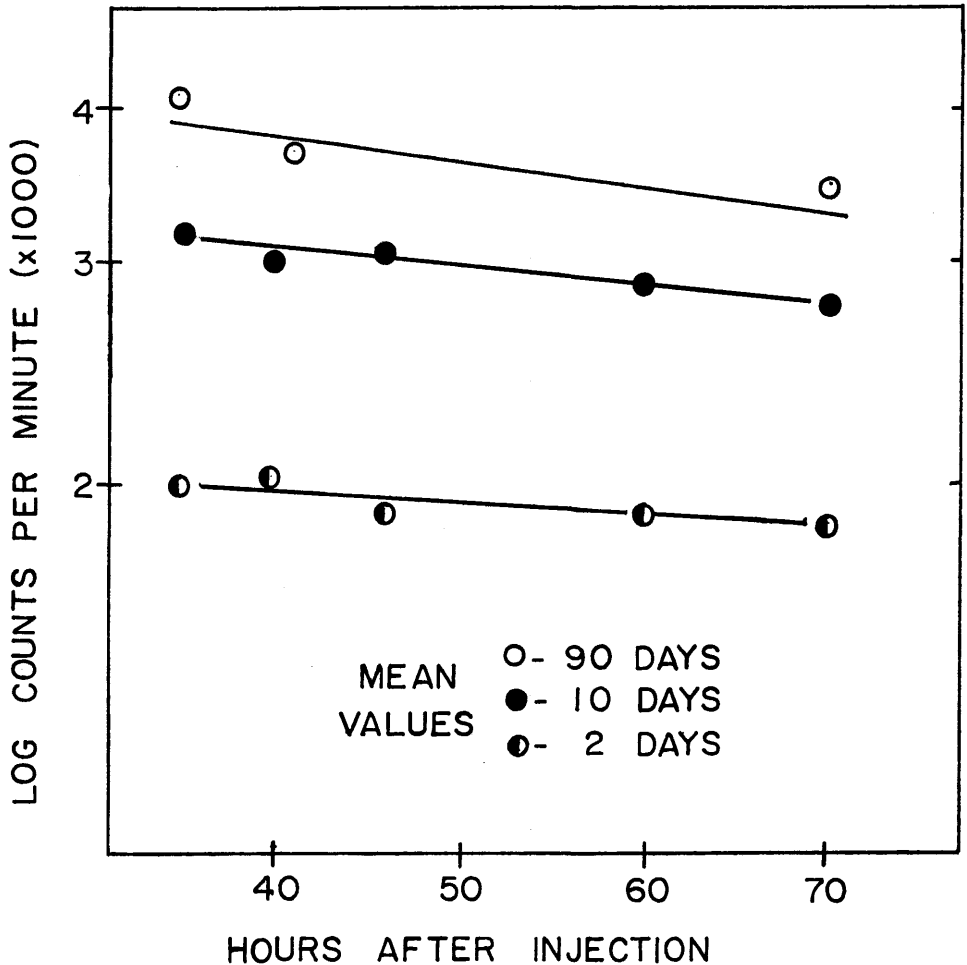


FIGURE 4. "Release slopes" of radioactivity calculated from 35 to 70 hr after injection of iodine-131, using Log. of mean counts-per-minute of birds tested 2, 10, and 90 days after capture.

DISCUSSION

The uptake and release curves for iodine-131, measured in the thyroid area are diphasic. Accumulation of iodine-131 from the blood by the glands ("uptake") results in increased radioactivity of the thyroid area. Release of iodine from the gland into the general circulation results in decreased radioactivity of this area. Harris (1955) says, "if the thyroid content of iodine-131 is taken to reflect the total amount of iodine-131 removed from the blood it is necessary to complete the measurements within 1-2 hours, since after this time iodine-131 will begin to be lost from the gland as radioactive hormone." Since the following discussion of uptake will deal with peak radioactivity occurring later than 1 to 2 hr after injection, it is of interest, regarding Harris' statement, that initial measurements in this study 1 hr after injection parallel the height of peak activity 15 to 20 hr later in each curve.

Uptake of Iodine-131

Harris (1955) reports that those workers using various chemical and physical

TABLE 2
Significance of points on curves of birds held 90 days—reserpine vs. no reserpine

Hours after injection	Means (cpm) of 8 birds given no reserpine	S.E.	Means (cpm) of 8 birds given reserpine	S.E.	Difference between the means	S.E. of the difference	"t"	"p"
1.0	2282	± 69	2928	± 253	646	± 268	2.41	<0.05
10.0	5667	± 243	5249	± 198	418	± 314	1.33	>0.05
15.0	4958	± 411	6712	± 199	1754	± 457	3.83	<0.01
20.0	5348	± 575	6966	± 347	1618	± 672	2.41	<0.05
25.0	5129	± 687	6645	± 415	1516	± 803	1.89	>0.05
30.0	4268	± 508	4506	± 122	238	± 522	0.46	>0.05
35.0	4341	± 488	3189	± 168	1152	± 516	2.23	>0.05
46.0	3581	± 362	4182	± 480	601	± 769	0.78	>0.05
55.0	3554	± 510	3734	± 341	180	± 614	0.29	>0.05
70.0	3081	± 308	3697	± 474	616	± 565	1.09	>0.05
80.0	3047	± 376	3159	± 496	112	± 646	0.17	>0.05
105.0	2801	± 383	2681	± 377	232	± 537	0.43	>0.05

TABLE 3
Significance of points on curves of birds held 2 days—reserpine vs. no reserpine

Hours after injection	Means (cpm) of 8 birds given no reserpine	S.E.	Means (cpm) of 8 birds given reserpine	S.E.	Difference between the means	S.E. of the difference	"t"	"p"
1.0	1237	± 104	877	± 20	360	± 106	3.39	<0.01
10.0	2150	± 355	2001	± 305	149	± 471	0.31	>0.05
15.0	1969	± 374	2222	± 418	253	± 561	0.45	>0.05
25.0	2118	± 321	2564	± 391	446	± 506	0.88	>0.05
30.0	2070	± 330	2173	± 391	103	± 512	0.20	>0.05
35.0	1999	± 306	1778	± 325	221	± 446	0.50	>0.05
40.0	2028	± 411	2231	± 413	203	± 583	0.35	>0.05
46.0	1837	± 309	2573	± 377	736	± 488	1.51	>0.05
60.0	1821	± 210	2576	± 446	755	± 493	1.53	>0.05
70.0	1791	± 219	1929	± 245	138	± 328	0.42	>0.05
86.0	1694	± 300	1534	± 322	160	± 440	0.36	>0.05
105.0	1525	± 193	1264	± 196	261	± 275	0.95	>0.05

conditions as stressful stimuli found that they inhibited radioiodine uptake in laboratory rats and rabbits. Money (1954) states that short-term stress is more effective in decreasing the collection of iodine-131 by the thyroid glands than is long-term stress; the latter results in no change in thyroid uptake of radioiodine.

It is not surprising, then, that the uptake of radioiodine in birds held only 2 days prior to testing should be depressed, assuming stress is inherent in the capture and caging of wild birds. Correspondingly greater uptakes in birds held for longer times possibly represents a return to normal thyroid functioning as the birds became increasingly more habituated to captivity.

Release of Iodine-131

Bogoroch and Timiras (1951) have shown that various types of stress lead to adrenal cortex activation, and that administration of cortisone or stress increases renal excretion of radioiodine in male hooded rats. Thus, the lower thyroidal

uptake values in House Sparrows with shorter caging intervals might result from increased renal excretion. Harris (1955), however, reports that stress (restraint for up to 44 hr) decreases thyroidal uptake and blood clearance of radioiodine in laboratory rabbits. Therefore, just considering radioiodine uptake values would probably not give a valid picture of thyroid activity *per se*. The following helps to obtain a better picture. Ninety-five per cent of radioiodine is normally protein-bound 40 hr after injection (Wolff and Chaikoff, 1948). Albert (1951), Perry (1951), and Wolff (1951) used logarithmically plotted release slopes of iodine-131 from about 40 hr after injection as an index of the secretion of organically bound iodine (thyroid hormone, presumably) by the thyroid glands. I did the same. Brown-Grant, Harris, and Reichlin (1954) found that emotional stress produced by various types of restraint and electrical shocks inhibited iodine release in laboratory rabbits. The small iodine release in birds held only 2 days may also be due to short-term stress effects which would, from the release slopes of birds held 10 and 90 days, seem ameliorated within several days following capture.

Effects of Reserpine

Since the uptake and release values for birds given reserpine do not differ significantly from those of untreated birds, it seems that reserpine does not influence the reactions of the thyroids to capture and caging conditions. Practical advantages of this regarding working with thyroid activities of wild-caught individuals is obvious, as "tranquilized" birds are easier to catch, handle, and transport.

General

Collective results may indicate a physical attribute of the overall phenomenon of habituation to captivity, an attribute which correlates with grossly observable behavior in this species. Such thyroid habituation here seems to proceed in a stepwise pattern, with hormone release "acclimatizing" earlier than uptake, for example. Whether these aspects possess threshold differences in their response to stress(es) or whether stress(es) itself decreases during captivity cannot be here answered, but it seems that, after at least 90 days of captivity, House Sparrow adjustments are probably maximal.

Whether these are *de facto* results of stress or due indirectly to other factors involved in captivity (diet, for example) is, however, not the most important point of this study. Differences in radioiodine uptake and release obtained from these data do nevertheless exist, and must be considered when making studies on wild-caught animals or comparing such work with that on laboratory animals.

Since reserpine is a widely known "tranquilizer," it seems surprising to note its absence of influence on thyroid responses to caging in this study. However, much is yet to be learned about both reserpine's actions and stress. Possibly other factors arising from captivity in this study resulted in the thyroid response obtained and, if so, these must be investigated.

ACKNOWLEDGMENTS

I am indebted to Dr. W. C. Dilger for advice and encouragement throughout this study and also wish to express my appreciation to him and Drs. Albert Wolfson and O. S. Pettingill, Jr. for reading and helpful comments concerning the manuscript. Thanks are also due the Ciba Pharmaceutical Company for supplying the Serpasil and Mr. David Allen for photographing the equipment used in this study.

LITERATURE CITED

- Albert, A. 1951. The *in vivo* determination of the biological decay of thyroidal radioiodine. *Endocrinol.* 48: 334-338.
Bogoroch, E. and P. Timiras. 1951. The response of the thyroid gland of the rat to severe stress. *Endocrinol.* 49: 548-556.

- Brown-Grant, K., G. W. Harris and S. Reichlin.** 1954. The effect of emotional and physical stress on thyroid activity. *J. Physiol.* 126: 29-40.
- Fink, B. A.** 1957. Radioiodine: A method for measuring thyroid activity. *Auk* 74: 487-493.
- Harris, G. W.** 1955. Neural control of the pituitary gland. Edward Arnold Ltd., London 298 p.
- Money, W. L.** 1954. The interrelation of the thyroid and the adrenals. *Brookhaven Symposia in Biology* No. 7. p. 137-168.
- Perry, W. F.** 1951. A method for measuring thyroid hormone secretion in the rat with its application to the bioassay of thyroid extracts. *Endocrinol.* 48: 643-650.
- Wolff, J.** 1951. Some factors that influence the release of iodine from the thyroid gland. *Endocrinol.* 48: 248-297.
- , and **I. L. Chaikoff.** 1948. Plasma inorganic iodide, a chemical regulator of normal thyroid function. *Endocrinol.* 42: 468-471.
-